(No Model.)

W. FRE

GRINDING MACH

No. 327,934.

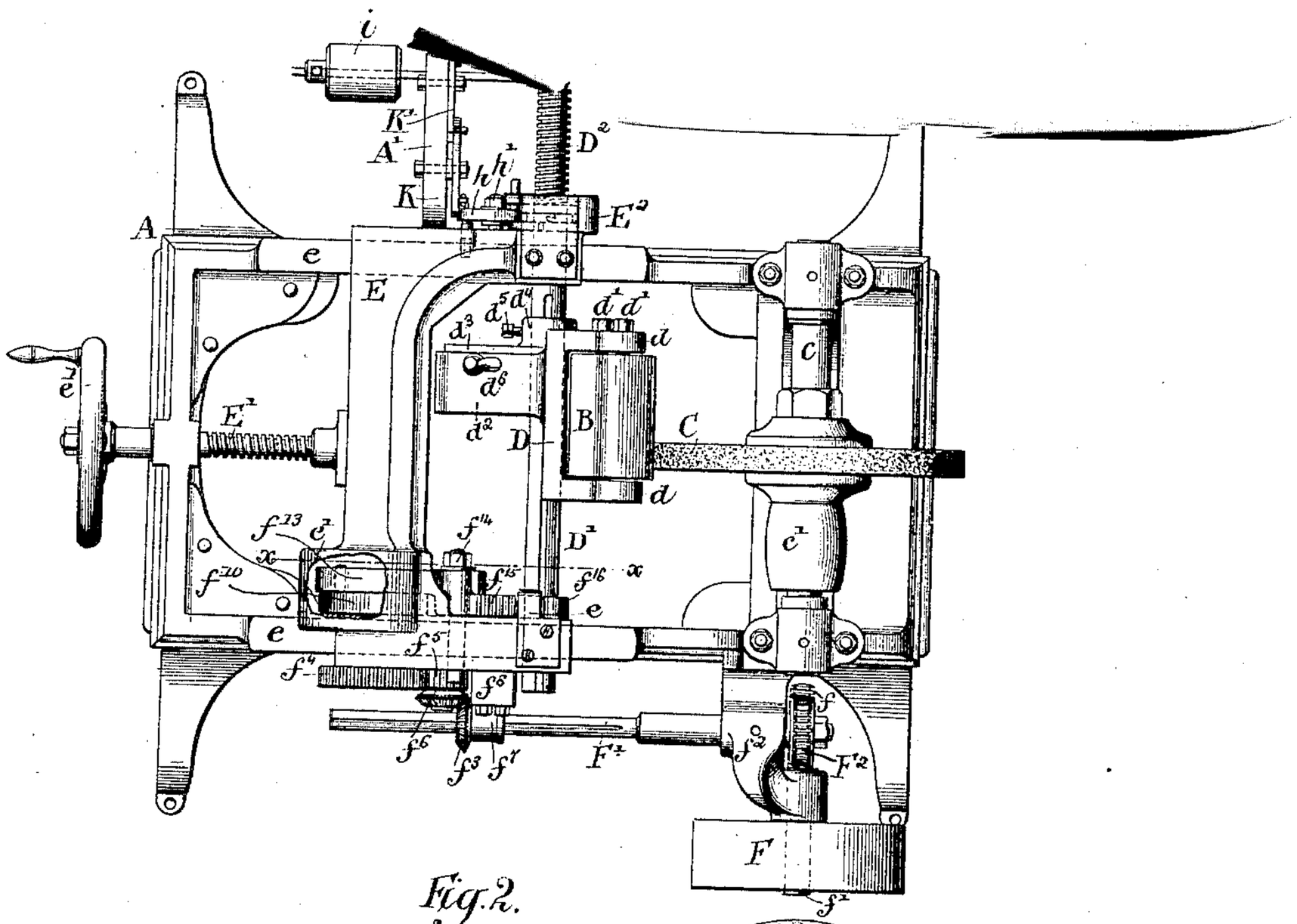


Fig. 2.

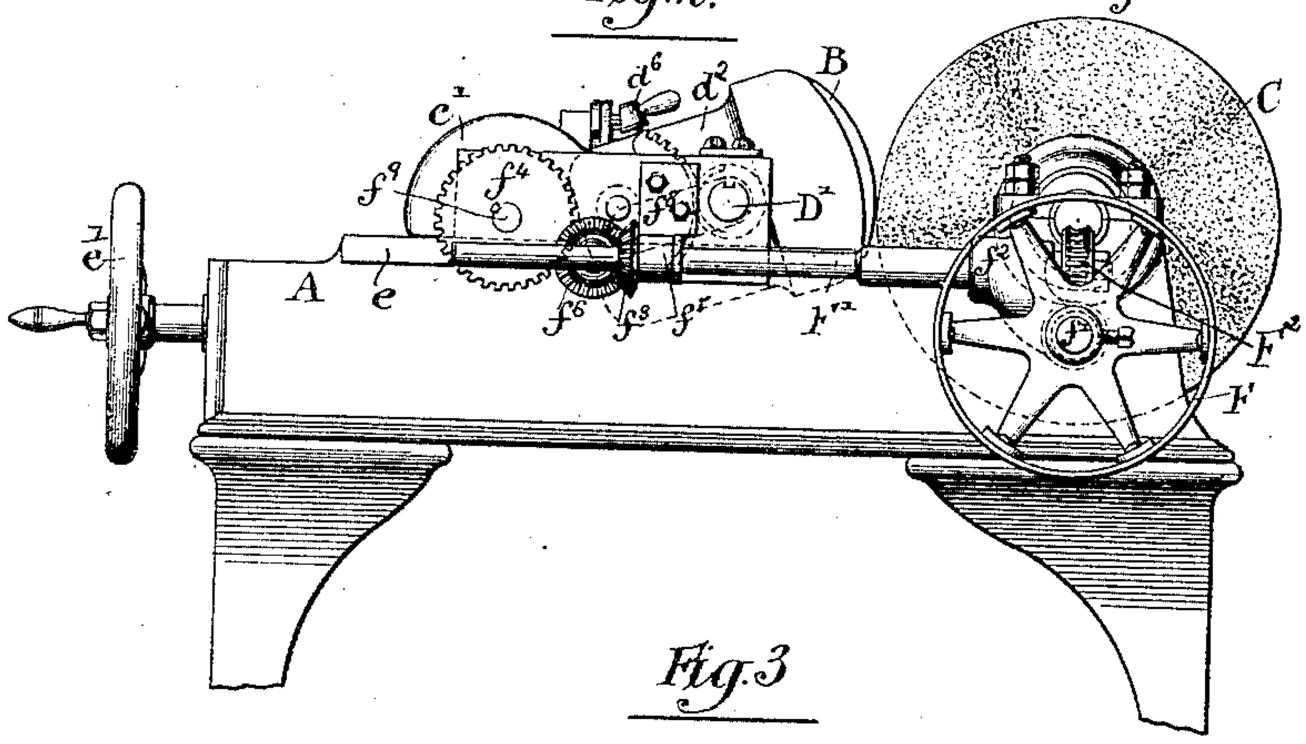
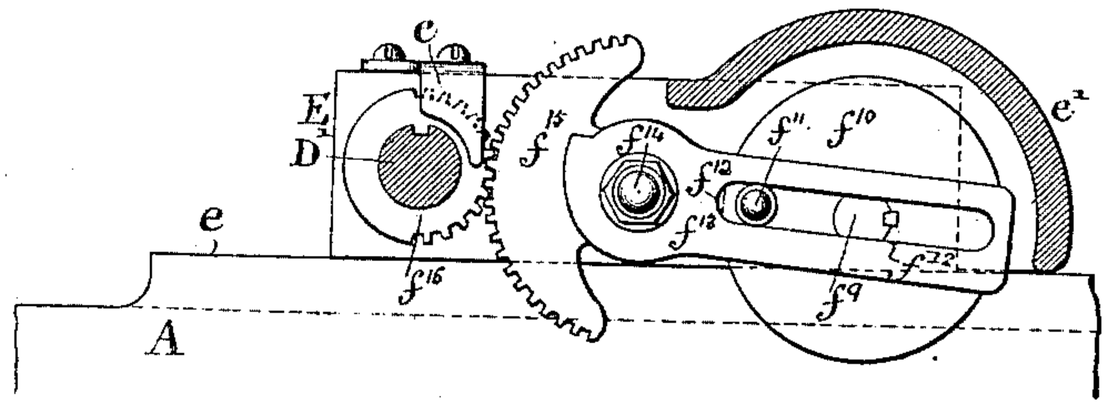


Fig. 3



Witnesses:-

Louis M. Whitehead.

C. C. Poole

Inventor:

William Frech,

by M. E. Dawson

Attorney.

(No Model.) 2 Sheets—Sheet 2.

W. FRECH.

GRINDING MACHINE.

No. 327,934. Patented Oct. 6, 1885

Fig. 4.

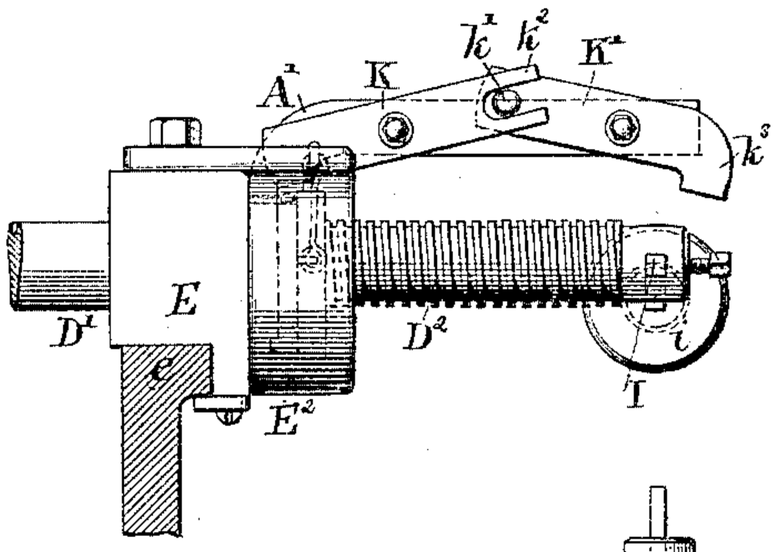


Fig. 5.

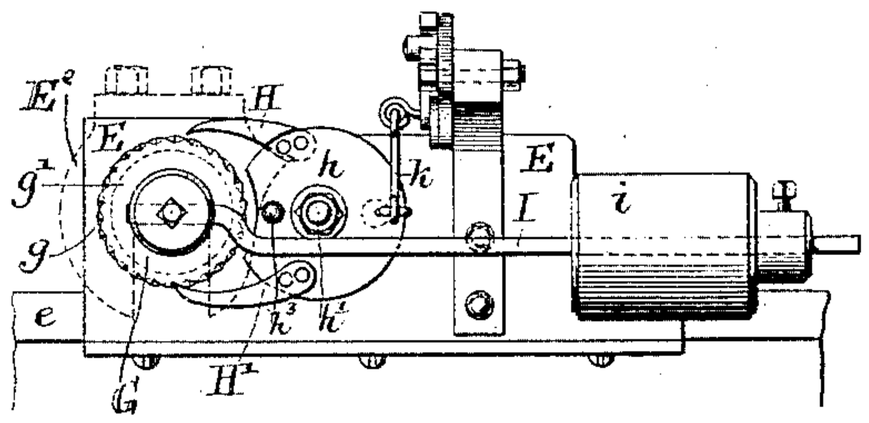


Fig. 6

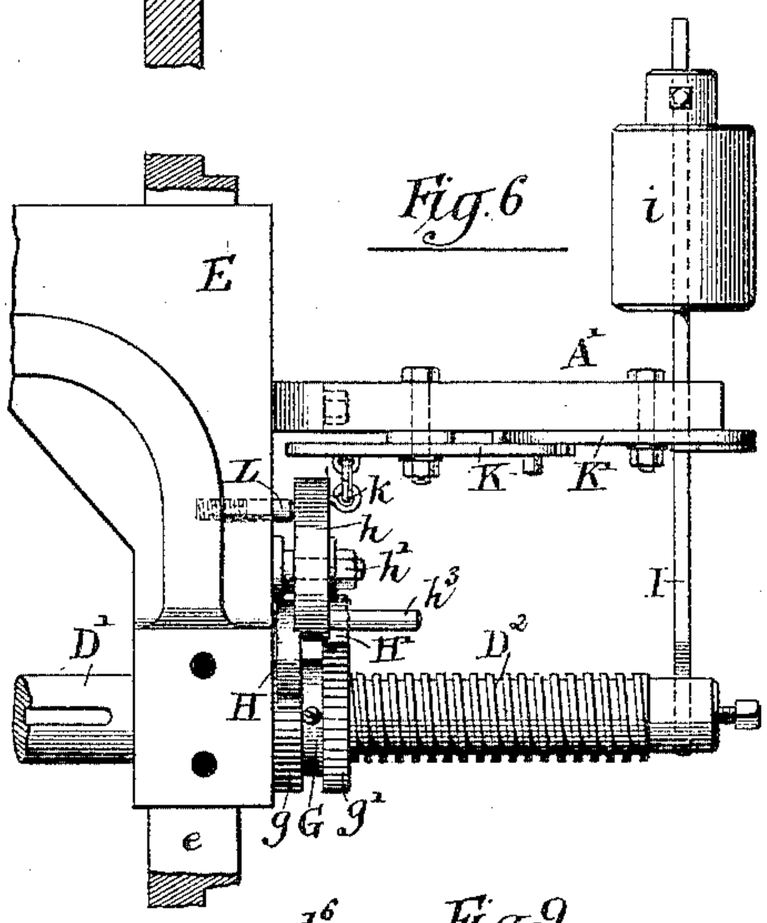


Fig. 7.

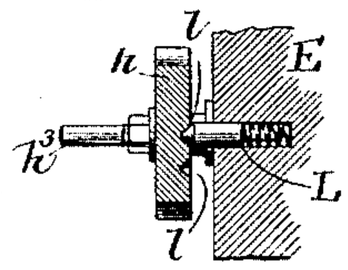


Fig. 8.

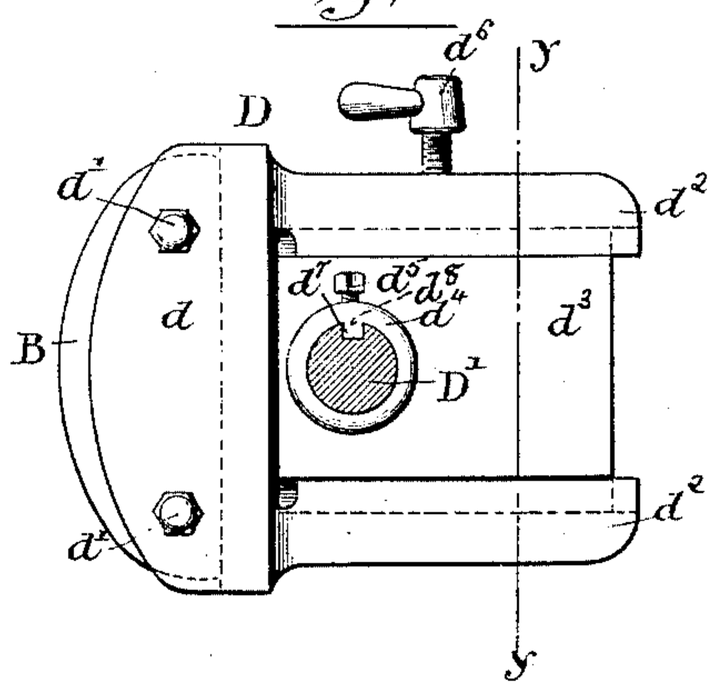
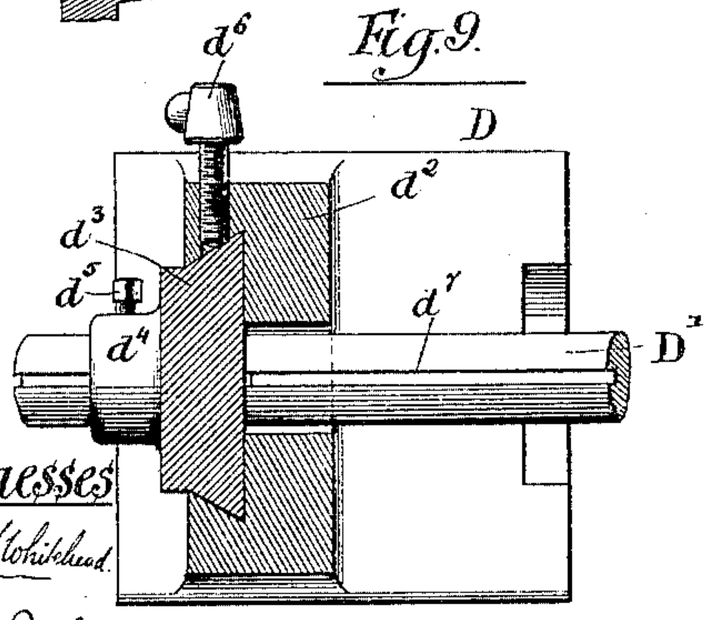


Fig. 9.



Witnesses
Louis W. Whitehead.
C. C. Poole

Inventor:-
William Frech
by W. E. Dayton
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM FRECH, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE A. FRENCH SPRING COMPANY, (LIMITED,) OF PITTSBURG, PENNSYLVANIA.

GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 327,934, dated October 6, 1885.

Application filed December 17, 1884. Serial No. 150,555. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM FRECH, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Grinding-Machines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The object of this invention is to provide an improved machine for grinding and truing the convex or party-cylindric surfaces of metal objects, and especially those of cast metal, which require their surfaces to be ground to a true cylindric surface, the machine herein shown being more particularly intended for grinding the convex surfaces of dies for forming elliptic springs.

The machine herein shown as embodying my invention is provided with a rotating grinding-wheel and with a work-holder which is susceptible of two movements—one an oscillatory movement and the other a reciprocatory movement in the direction of its axis of oscillation—the said work-holder being moved in the operation of the machine, so as to present the entire area of the surface to be ground to the action of the said abrading-wheel. These two movements of the work-holder are attained by a rocking and longitudinally-reciprocating shaft which supports the work-holder, and which is mounted in or upon a sliding carriage adapted to move toward or away from the grinding-tool, so that the work may be properly advanced to the said tool. The longitudinal or end motion of the shaft is produced through the medium of a mechanism actuated by the rocking motion of the shaft, and the reversal of the end motion of the shaft is automatically effected at the proper moments through the medium of devices hereinafter described.

The invention may be more readily understood by reference to the accompanying drawings, in which Figure 1 is a top plan view of a machine constructed in accordance with my invention, with a portion of a box on the carriage broken away, so as to show a rotary disk arranged on said box. Fig. 2 is a side elevation of the machine at that side at which the devices for rocking the shaft are arranged. Fig. 3 is a sectional detail, on a slightly-larger scale, taken on a vertical plane indicated by the line *x x* of Fig. 1. Fig. 4 is a sectional detail view showing the screw-threaded end of the rock-shaft and means for reversing the direction of the longitudinal motion of the shaft. Fig. 5 is a detail elevation of the devices shown in Fig. 4. Fig. 6 is a top plan view of a part of the carriage and the devices for moving the shaft longitudinally. In this view the box E^2 (shown in Fig. 4) is removed for convenience of illustration. Fig. 7 is a sectional detail view taken upon line *x x* of Fig. 5, showing a pivoted pawl-support and a spring-controlled stop for maintaining the said support in operative position. Fig. 8 is a section taken transversely through the rock-shaft at one side of the work-holder, which latter is shown in elevation. Fig. 9 is a sectional view of the work-holder, taken upon the line *y y* of Fig. 8.

Referring by letter to the parts shown in the several figures of the drawings, A indicates a suitably-constructed frame, which is provided with bearings for the several moving parts of the machine.

B is a block or blank to be operated upon, the block shown being a male die for forming elliptical car-springs, and C is a grinding-wheel, which is located near one end of the main frame, and is secured on a transversely-arranged horizontal rotary shaft, *c*, mounted in suitable bearings upon the said frame. This shaft is provided with a suitable belt-pulley, *c'*, whereby the shaft and the grinding-wheel thereon are rotated.

The die B or other work to be ground is secured in a holder, D, in position to present its curved face to the grinding-tool or abrading-wheel, and the holder for the die is secured upon a horizontal shaft, D', arranged parallel with the shaft carrying the grinding-wheel, and having both a rocking and an endwise reciprocatory motion, whereby the entire curved face of the die may be presented to the grinding-wheel.

The work-holder D may be of any shape or construction suitable for the purpose, but, as herein shown, it consists of a recessed casting provided with a pair of jaws, *d*, between which the die is held by means of set-screws *d'*, Figs. 1 and 8, said set-screws preferably passing through one side of the yoke and bearing against the die. The work-holder shown is made of rectangular shape to accommodate it to the form of die, although it may obviously be made of any shape required by the form of blank to be held thereon. The work-holder is preferably formed with a flat arm, d^2, extending back from the middle portion of the yoke, and provided in one side with a longitudinal dovetailed groove, in which a correspondingly-dovetailed block, d^3, Figs. 8 and 9, upon the shaft D' is received. As a means of connecting the block d^3 with the shaft, the said block is apertured near one end to admit the shaft, and is preferably provided with a hub, d^4, adjacent to the shaft-aperture, through which is inserted a set-screw, d^5, bearing upon the shaft, whereby the said holder may be held in a desired position upon the shaft. A set-screw, d^6, is inserted through one of the arms d^2 of the work-holder for clamping the latter upon the block d^3, so that the said work-holder may be adjusted radially with reference to the shaft in order to permit the radius of the curved surface of the work to be varied, as desired. The block d^3, for thus supporting the work-holder, is adapted to slide longitudinally, but not to rotate upon the shaft, for which purpose the shaft may be provided with a longitudinal groove, d^7, with which a spline, d^8, upon the hub is engaged, the object of this connection between the hub and the shaft being to permit the die-holder to be adjusted along the shaft for the purpose of adjusting the position of the work to the grinding-wheel.

The rocking and longitudinally-reciprocating shaft carrying the die-holder is mounted, at its ends, in a carriage, E, by means of which the shaft and the work supported thereon can be moved forward or fed to the grinding-wheel. The carriage E is supported by and travels upon suitable guides *e*, at the sides of the main frame, and is operated by an adjusting-screw, E', having a bearing in one end of the main frame, and provided with a suitable hand or crank wheel, *e'*.

The shaft D', carrying the die-holder, derives its rocking or oscillatory motion from a belt-pulley, F, through the medium of a mechanism designed to convert the rotary motion of the belt-pulley into an oscillatory or rocking motion, and at the same time to permit the shaft to be shifted or moved laterally. In the devices herein shown for this purpose the belt-pulley F is arranged at one side of the machine, and actuates a rotary shaft, F', through the medium of a worm-gear, *f*, a convenient disposition of said members being shown, in which the belt-pulley is secured on a spindle, *f'*, provided with a worm and mounted on a bracket, f^2, on the main frame, the rotary shaft F' being arranged parallel with the length of the machine, and provided at one end with a worm-wheel, F^2, engaged by the worm on the belt-pulley spindle. The rotary shaft F' is provided with a sliding bevel-gear, f^3, which latter transmits motion from the shaft to a gear, f^4, at one end of the carriage, through the medium of a pinion, f^5, Fig. 1, supported from the carriage and rigid with a bevel-gear, f^6, which engages the bevel-gear f^3 on the rotary shaft F'. The bevel-gear f^3 rotates with the shaft F', but is permitted to slide along the same in conjunction with the movement of the carriage E, for which purpose the said bevel-gear may, as shown, for example, be provided with a spline or feather engaged with a longitudinal groove in the shaft and arranged to turn in a hub or sleeve, f^7, connected with a part, f^8, of the carriage. The spindle f^9 of the gear f^4 carries a disk, f^{10}, Figs. 1 and 3, which is secured on said spindle, and is provided at one side with a wrist-pin, f^{11}, which engages in a slot, f^{12}, in one arm of a vibratory lever, f^{13}. This vibratory lever is mounted upon a stud, f^{14}, on the carriage, and is provided upon its arm opposite to that mentioned with a segmental gear, f^{15}, engaging a segmental gear, f^{16}, on the rock-shaft D'. The oscillations of the geared lever f^{13}, thus engaging a gear on the rock-shaft, serve to rock the latter, and in order to permit the rock-shaft to have a reciprocating end movement, derived from devices hereinafter described, the gear f^{16} is provided with a feather entering a groove in the rock-shaft and confined between one of the sides of the carriage and a suitable plate or stop, *e*, on the carriage in such way as to permit the gear to oscillate with the shaft, and at the same time to permit the shaft to slide freely through the gear.

The disk f^{10} is covered by a suitable box, *e'*, in or on the carriage, which box is shown in section in Fig. 3, and in Fig. 1 is shown as partially broken away to expose a portion of the disk.

The devices herein shown and preferably used for effecting an end reciprocation of the rock-shaft carrying the work are constructed as follows: The said shaft is mounted in bearings which are situated at the two opposing sides of the carriage and adapted to permit a free longitudinal or end movement on the part of the shaft. The rock-shaft extends at one of its ends beyond one of the sides the of carriage, and is at said end provided with a screw-threaded portion, D^2. On this screw-threaded portion of the rock-shaft is located an internally-threaded hub or nut, G, (Figs. 5 and 6,) provided with two separate ratchet-wheels, *g* and *g'*, the teeth of which are inclined in opposite directions, so that one is a right-hand and the other a left-hand ratchet. The said nut G is confined within a box, E^2, at one side of the carriage, which box, while permitting the nut to turn with the shaft, pre-

vents any end movement with said shaft, so that when the nut is held from rotation during the rotary movement of the shaft in either direction by either pawl the shaft will be compelled to move in the direction of its length.

To effect the longitudinal reciprocation of the shaft, the ratchets *g* and *g'* are alternately engaged by one and the other of a pair of pawls, H and H', under an arrangement by which, during a number of rocking movements of the shaft, the nut will be held by one pawl against turning one way with the rock-shaft, so as to cause an end movement of the said shaft in one direction, and during a succeeding number of rocking movements the nut will be held against turning in the opposite direction with the rock-shaft, so as to cause an end movement of the shaft in a direction reverse to its preceding movement, and so on. To such end the pawls H and H' are respectively pivoted to opposite sides of a disk, *h*, which is loosely mounted on a stud, *h'*, secured in and extending from one side of the carriage E, Figs. 1, 5, and 6. The pawl H is so located that it will be brought into engagement with the ratchet *g* when the disk *h* is in one position, and the pawl H' is placed in such manner that it will engage the ratchet *g'* when the said disk is in another position. The movement of the disk *h* to bring it into the positions mentioned is effected by mechanism constructed as follows: The rock-shaft D' carries at the terminal of its screw-threaded end portion a weighted arm, I, which vibrates with the axial oscillations or rocking motion of the shaft, the weight *i* on said arm serving to balance the work-holder, and being adjustably secured on said arm. This arm, aside from supporting the weight, is designed to act at the termination of the end movement of the rock-shaft in one direction on devices for turning the disk carrying the pawls, to an extent which shall throw one pawl out of engagement with its corresponding ratchet, and simultaneously therewith bring the remaining pawl into engagement with its ratchet, and, conversely, at the required termination of the end movement of the rock-shaft in an opposite direction, to turn the disk so as to reverse the positions of the pawls and throw the pawl previously engaging a ratchet out of engagement therewith, and to simultaneously bring the other pawl into engagement with its allotted ratchet.

The termination of the end movements of the rock-shaft in a direction to carry the arm I outwardly is attained by a connected pair of levers, K K', each pivoted to an arm, A', extending laterally from the main frame of the machine. The lever K is flexibly connected with the disk *h* by a link, *k*, and the levers are connected together at their meeting ends by means of a stud, *k'*, on one lever, extending into a slot, k^2, in the other lever.

When the rock-shaft D' reaches the end of its longitudinal movement in the direction mentioned, as illustrated in Fig. 6, its arm I will engage the outer end, k^3, of the lever K' and raise the latter at said end, thereby causing said lever to turn the lever K about its pivot in a direction which shall lift the link *k*, connecting the lever K with the disk *h*, thereby turning said disk, so as to bring pawl H into engagement with the ratchet *g* on the nut G, and throwing the pawl H' out of engagement with the ratchet *g'* on the said nut; but at the required termination of the end movement of the rock-shaft in a reverse direction, the arm I on the rock-shaft strikes upwardly against a pin, h^3, located in proper position for this purpose in the disk *h*, whereby the the said disk is turned in a direction opposite to its preceding movement, so as to bring the pawl H' into engagement with the ratchet *g'* on the nut G and throw the pawl H out of its engagement with the ratchet *g*. By this construction it will be seen that during a determinate succession of oscillations on the part of the rock-shaft carrying the work one pawl—for example, the pawl H'—will be held in engagement with one of the ratchets on the nut, while the remaining pawl will be out of engagement with its ratchet. During such conditions the pawl H will ride on its ratchet to permit the latter to turn with the rock-shaft in one direction, but will hold the ratchet against rotating with the rock-shaft in its reverse rotary motion, thereby compelling an end movement of the latter, so as to move the work-holder laterally. This operation will continue until the rock-shaft has moved longitudinally to the extent to which it is found desirable to shift the work after each passage of the grinding-wheel over it, by which movement the arm I, acting on the lever K, will, through the medium of the devices already described, move the disk *h* about its pivot, so as to throw the pawl H' out of engagement with its ratchet on the nut G, and thereby bring the pawl H into engagement with its allotted ratchet on said nut. In a similar manner, during the succeeding oscillations of the rock-shaft the pawl H will come into play and cause a reverse longitudinal or end movement of the rock-shaft until the arm I on the latter acts on the pin h^3 of the rock-shaft and again reverses the order of the engagement of the pawls.

In order to hold the disk or pawl support *h* in its two positions, a spring-actuated stop, L, is herein shown as supported by the carriage and arranged to bear against the inner side of the disk, which is provided in said side with two recesses, *l*, in such position that the stop will be in one or the other of said recesses when the disk is in position to bring one or the other of its pawls into engagement with one or the other of the ratchets. The outer end of the stop is beveled, so that it will readily slide back and out of a recess when the disk is turned, as before described.

The pawls H and H' are preferably secured rigidly upon the disk *h*, the requisite movement in said pawls to allow them to pass over the teeth of the ratchet-wheel being permitted

by the yielding of the stop L, which, by the engagement of its beveled or conical end with the recesses *l*, operates to retain the pawls in position to engage the teeth.

It will be seen that in the operation of the machine above described the rock-shaft will, when moved longitudinally by the action of the nut G, have a compound motion which is the resultant of its end movement and its oscillatory movement. The said end movement of the shaft will occur, however, during the rotary movement of the said shaft in one direction only, so that the work will have a combined oscillatory and lateral movement when it is moving about the axis of the shaft in one direction, but will have no lateral motion when traveling in an opposite direction.

The grinding-wheel may of course be caused to go over the surface of the work as many times as is found necessary, the work being fed up to the wheel as the surface thereof is ground away by the use of the hand-wheel *e'* and the shaft E' in a familiar manner.

It is to be understood that my invention is not limited to the exact features of construction embodied in the machine herein shown as one way of carrying out the broad features of my invention, excepting in the specific claims in which said features of construction are particularly set forth.

It is to be understood, also, that the said claims cover the devices, parts, or elements composing said devices, therein set forth, when said devices, parts, or elements are made in form to obtain either, any, or all of the purposes, objects, functions, or advantages obtained by or existing in the said devices, parts, or elements in the particular form thereof herein shown.

I claim as my invention—

1. The combination, with a rotary grinding-tool supported in stationary bearings, of an oscillatory work-holder having a reciprocatory movement in the direction of its axis of oscillation, substantially as and for the purpose set forth.

2. The combination, with a suitable frame, of a grinding-tool, an oscillating work-holder having a reciprocatory movement in the direction of its axis of oscillation, and a sliding carriage supporting said work-holder and having adjustable connection with the frame, substantially as and for the purpose set forth.

3. The combination, with a suitable frame, of a grinding-tool, a work-holder, a longitudinally-movable rock-shaft supporting said work-holder, and having an oscillatory movement, and also a longitudinal reciprocating movement, substantially as and for the purpose set forth.

4. The combination, with a machine-frame and a work-holder, of a horizontally-movable rock-shaft supporting said work-holder, provided with a screw-thread in a portion of its length, a nut engaged with the screw-threaded portion of the shaft, a stop constructed to hold the nut from movement longitudinally of the shaft, and a pawl and ratchet or equivalent device applied to hold the nut from rotation with the shaft when the shaft is turned in one direction, whereby the said shaft is moved longitudinally when oscillated, substantially as and for the purpose set forth.

5. The combination, with the machine-frame, of a horizontally-movable rock-shaft having a screw-threaded portion, a nut provided with right-hand and left-hand ratchets, stops for holding the nut from movement horizontally of the shaft, pawls to engage said ratchets, and a movable support for the said pawls, substantially as and for the purpose set forth.

6. The combination, with the machine-frame, of a longitudinally-movable rock-shaft having a screw-threaded portion, a nut provided with right-hand and left-hand ratchets, stops for holding said nut from end movement with the shaft, pawls engaged with said ratchets, and a movable support for said pawls, actuated by the longitudinal movement of the shaft, substantially as and for the purpose set forth.

7. The combination, with the longitudinally-movable rock-shaft having a screw-threaded portion, of a nut provided with right-hand and left-hand ratchets, stops constructed to hold said nut from end movement with the shaft, pawls engaged with the said ratchets, a movable support, *h*, for said pawls, and an arm upon the said rock-shaft constructed to engage and move the said support *h*, so as to change the direction of longitudinal motion of the shaft, substantially as and for the purpose set forth.

8. The combination, with the longitudinally-movable rock-shaft having a threaded portion, of a nut provided with right-hand and left-hand ratchets, stops to hold the nut from movement longitudinally of the shaft, pawls engaged with the ratchets, a movable pawl-support, *h*, a series of connected levers united with the pawl-support, and an arm upon the said shaft constructed to actuate the levers, so as to move the pawl-support at a desired point in the movement of the said arm in a direction away from the said support, substantially as and for the purpose set forth.

9. The combination, with the longitudinally-movable rock-shaft provided with a threaded portion and having an arm, I, of a nut provided with right-hand and left-hand ratchets, stops constructed to hold said nut from movement longitudinally of the shaft, pawls constructed to engage said ratchets, a movable pawl-support, *h*, provided with a stud, h^3, and levers K and K', one of which is connected with the pawl-support, substantially as and for the purpose set forth.

10. The rocking and longitudinally-movable shaft D', supporting the work-holder and screw-threaded at one end, in combination with the nut G, provided with right-hand and left-hand ratchets, pawls adapted for engagement with the ratchets, a pivoted pawl-holder, *h*, supporting the said pawls, and a spring-actuated stop engaged with the pawl-holder

and constructed to hold the pawls in position for engagement with the ratchets, substantially as described.

11. The combination, with a grinding-tool, of a longitudinally-movable rock-shaft, D′, and the work-holder D, mounted upon the shaft and adjustable longitudinally of the latter, substantially as described.

12. The combination, with a grinding-tool, of a longitudinally-movable rock-shaft, D′, and a work-holder supported upon the rock-shaft and adjustable bodily toward and from the said shaft, substantially as and for the purpose set forth.

13. The combination, with a grinding-tool, of a longitudinally-movable rock-shaft, D′, a work-holder, D, and a block, d^3, secured to the shaft and having sliding connection with the work-holder, substantially as and for the purpose set forth.

14. The combination, with the longitudinally-movable rock-shaft D′ and the work-holder D, of the block d^3, constructed to slide longitudinally, but not to rotate upon the shaft, and having sliding connection with the work-holder, and set-screws or equivalent devices for adjustably securing the said block upon the shaft and the work-holder upon the block, substantially as described.

15. The combination, with the machine-frame, of the work-holder, the longitudinally-reciprocating rock-shaft D′, supporting said holder, a gear-wheel, f^{16}, connected with the shaft by a spline engaged with a corresponding groove in the shaft, a lever provided upon one end with a segmental gear engaging said wheel f^{16} and with a slot, f^{12}, in its opposite end, and a revolving crank-disk, f^{10}, provided with a pin engaged with said slot, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

WILLIAM FRECH.

Witnesses:
C. CLARENCE POOLE,
OLIVER E. PAGIN.